REMARKS

This paper is filed in response to the final official action dated November 12, 2009. This paper is filed with a petition to revive an unintentionally abandoned patent application, a request for continued examination, and payment of the requisite fees. The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith, to our Deposit Account No. 13-2855, under Order No. 30848/40704.

Claims 1-5 and 7-13 are pending. By the foregoing, claims 12 and 13 have been amended and new claim 14 has been added. Support for the amendments to claims 12 and 13 can be found in the specification, for example, at p. 4 in the description of the homo- and copolymer examples, and at p. 5, Table I. Support for claim 14 can be found in the specification, for example, at p. 3, lines 1-9. No new matter is added. The fee for one additional independent claim in excess of three is included herewith.

Claims 1-5 and 7-13 stand rejected. Claims 1-5 and 7-13 have been rejected under 35 U.S.C. § 112, first paragraph, as assertedly failing to comply with the written description requirement.[1] Claims 1-5, 9, 10, 12, and 13 have been rejected under 35 U.S.C. § 103(a) as assertedly obvious over U.S. Patent No. 6,420,084 ("Angelopoulos") in view of U.S. Patent No. 5,484,867 ("Lichtenhan"). Claim 11 has been rejected under 35 U.S.C. § 103(a) as assertedly obvious over Angelopoulos and Lichtenhan further in view of U.S. Patent Publication No. 2002/0150935 ("Nishi"). Claims 7 and 8 have been rejected under 35 U.S.C. § 103(a) as assertedly obvious over Angelopoulos and Lichtenhan further in view of U.S. Patent No. 6,344,305 ("Lin").

Rejections under 35 U.S.C. § 112, first paragraph

Claims 1-5 and 7-13 have been rejected under 35 U.S.C. § 112, first paragraph as failing to comply with the written description requirement for reciting "a random copolymer bearing at least one polyhedral oligomeric silsesquixoane group." Applicants respectfully submit that support for recitation of a random copolymer can be found in the specification, for example, at p. 4, lines 6-25, which describes a procedure for making the random copolymers recited in the claims. One of ordinary skill in the art would readily understand that the disclosed procedure results in formation of a random copolymer. In view of the

[1] The action indicates that claims 1-13 were rejected under § 112, first paragraph, but only claims 1-5 and 7-13 are pending.

foregoing, it is submitted that the recitation of "a random copolymer bearing at least one polyhedral oligomeric silsesquioxane group" is supported by the specification as originally filed.

Claim 12 has been rejected under 35 U.S.C. § 112, first paragraph as failing to comply with the written description requirement for reciting the range 20-60 wt.%. Applicants respectfully submit that the disclosure of 20, 30, 40, and 60 wt.% in Table 1 of the specification as originally filed provides a sufficient description of a representative number of species to support the generic range of 20-60 wt.%. Specifically, the disclosure of both endpoints of the recited range and two points between said endpoints clearly demonstrates the Applicants' possession of the recited range. This assertion is completely logical – if two "end points" are suitable for a material and two additional points there between are also suitable, one of ordinary skill would readily assume that each point within said end points are suitable for the material. As a result, one of ordinary skill in the art could readily predict the operability of any of the species within the claimed range, other than the ones specifically disclosed. In view of the foregoing, it is submitted that claim 12 is supported by the disclosure as originally filed.

Reconsideration and withdrawal of the rejections of claims 1-5 and 7-13 under 35 U.S.C. § 112, first paragraph are respectfully requested in view of the foregoing remarks.

Rejection under 35 U.S.C. § 103(a)

Claims 1-3, 7, 9, and 11-13 recite a material that contains a random copolymer bearing at least one polyhedral oligomeric silsesquioxane group, wherein the alkyl substituents of the polyhedral oligomeric silsesquioxane group which are not linked to the main chain (backbone) of the polymer contain up to 3 carbon atoms. Claims 4, 5, 8, and 10 similarly recite a random copolymer bearing at least one polyhedral oligomeric silsesquioxane group, wherein the alkyl substituents of the polyhedral oligomeric silsesquioxane group which are not linked to the main chain (backbone) of the polymer comprise ethyl groups.

There is no teaching or suggestion in either Angelopoulos or Lichtenhan to select the alkyl substituents of the POSS group which are not linked to the main chain (backbone) of the polymers disclosed therein to have (only) up to 3 carbons. Rather, Angelopoulos simply discloses a material having a polymer bearing a cage structure, which can be a POSS group. *See* Angelopoulos, col. 5, lines 50-67. Angelopoulos is silent as to the alkyl substituents that

can be included on the POSS group, much less the effect of the alkyl substituents on the pattern forming properties of the materials. Lichtenhan is directed to a method of making polymers containing POSS segments, but does not disclose or suggest the use of a POSS group in a polymer for use as a lithographic material. Lichtenhan only generally discloses that the POSS group can include monovalent hydrocarbon substituents having 1 to 20 carbon atoms selected from the group consisting of aryl or alkyl groups such as methyl, ethyl, propyl, butyl, hexyl, heptyl, octyl, cyclohexyl, and phenyl groups. *See* Lichtenhan, col. 5, lines 42 to col. 6, line 2. Lichtenhan further discloses that the R substituents can be also similarly sized alkenyl groups or alkoxy groups. There is no recognition in any of the cited references that the alkyl substituents of the POSS could affect the performance of the polymer as a lithographic material, and thus no motivation for selecting a particular functional group (i.e., alkyl substituents containing up to 3 carbons) for the substituents of the POSS group which are not linked to the main chain (backbone) is provided.

In contrast, Wu *et al.*, J. Vac. Sci. Technol. B 19(3), May/June 2001, pp. 851-855 (cited by the applicants in the IDS filed March 21, 2005; hereafter "Wu"), which the applicants consider to be the closest prior art, specifically discloses the intentional selection of cyclopentyl substituents on a POSS group in a methacrylate-based material for optical lithography. In this respect, Wu explains:

> Polyhedral oligosilsesquioxane methacrylate (POSS) is a structurally well-defined monomer that has an inorganic silica-like core as shown in Fig. 1. *The core is surrounded by seven cyclopentyl groups on the corners for stability and solubility.* This unique monomer contains both the aforementioned plasma-resistant elements, namely high carbon-to-hydrogen ratio cyclopentyl groups and an inorganic silica cage. It is anticipated that incorporation of this monomer into methacrylate polymers will impart enhanced plasma etch resistance.

See Wu at page 851, the paragraph bridging columns 1-2. Wu further emphasizes the intentional selection of the *cyclic aliphatic* cyclopentyl groups by disclosing that "the silica cage is surrounded by seven cyclopentyl groups, which could afford POSS even higher etch resistance," and "the seven cyclic aliphatic groups around the cage corners can assist in increasing the etch resistance in oxygen for these POSS containing samples." *See* Wu at page 853, the first paragraph of column 1, and at page 854, the paragraph bridging columns 1 and 2, respectively.

The inventors have discovered that a material comprising a random copolymer bearing a POSS group with alkyl substituents which are not linked to the main chain (backbone) of the random copolymer containing up to 3 carbon atoms unexpectedly and beneficially demonstrates decreased rms roughness as compared to a homopolymer having a POSS group with alkyl substituents which are not linked to the main chain (backbone) of the random copolymer containing greater than 3 carbons. The decreased rms roughness can allow for formation of smooth, high quality structures after pattern transform, which, in turn, can allow for high resolution pattern transfer.

These unexpected results are demonstrated, for example, in Example 3 of the specification, which compares the roughness of a MethacrylEthyl-POSS homopolymer and a MethacrylCyclopentyl-POSS homopolymer made using the MethacrylCyclopentyl-POSS monomer disclosed by Wu. As shown in Example 3, the MethacrylEthyl-POSS homopolymer (i.e., having POSS groups bearing ethyl substituents) demonstrates significantly lower roughness as compared to MethacrylCyclopentyl-POSS homopolymer (i.e., having POSS groups bearing cyclopentyl substituents as disclosed by Wu). Specifically, the rms roughness of the MethacrylCyclopentyl-POSS homopolymer was 14.8 nm, while the rms roughness of the MethacrylEthyl-POSS homopolymer was less than 1 nm. *See* the specification, Example 3, p. 6, lines 24-26. The applicants respectfully submit that the advantages of using polymers (and copolymers) comprising MethacrylEthyl-POSS monomers relative to polymers (and copolymers) comprising MethacrylCyclopentyl-POSS monomers are best shown by comparing polymers containing 100 wt. % of each monomer, i.e., by comparing the corresponding homopolymers. Furthermore, as illustrated in Example 4, copolymers formed using the MethylacrylEthyl-POSS monomer had rms roughness of less than 1 nm. *See* Example 4, at p.7, lines 9-10. Such unexpected, beneficial results were not recognized in any of the cited references or in Wu.

It is believed that the decreased roughness is achieved in the claimed invention by using ethyl groups or groups with similar size as the alkyl substituents. *See* the specification at p. 3, lines 21-26. The specification discloses that such similarly sized groups include groups with 1-3 carbon atoms. Given this explicit evidence in the specification of a relationship between the size of the alkyl substituents and the surface roughness, one of ordinary skill in the art would ascertain that the results obtained using an ethyl substituent as exemplified in Examples 3 and 4 can be reasonably extended to other alkyl substituents

having a similar size to ethyl groups (i.e., substituents with 1-3 carbons). *See* MPEP 2145 ("For example, a showing of unexpected results for a single member of a claimed subgenus, or a narrow portion of a claimed range would be sufficient to rebut a *prima facie* case of obviousness if the skilled artisan 'could ascertain a trend in the exemplified data that would allow him to reasonably extend the probative value thereof.'" (quoting *In re Clemens*, 622, F.2d 1029, 1036 (CCPA 1980)). Accordingly, it is submitted that the demonstrated unexpected results are commensurate in scope with claimed invention as recited in claims 4, 5, 8, and 10 (which recite random copolymers having POSS groups with ethyl substituents) and claims 1, 3, 7, 9, and 11-13 (which recite random copolymers having POSS groups with alkyl substituents containing up to 3 carbon atoms).

The Action asserts that the evidence of unexpected results does not compare the claimed invention to the closest prior art. *See* the Action at p. 7. To rebut a *prima facie* case of obviousness, the evidence submitted must compare the claimed invention with the closest prior art. *However, the applicant is not required to compare the claimed invention with subject matter that does not exist in the prior art.* MPEP § 716.02(e) III. (noting that requiring comparison with a combination of references supporting a rejection under 35 U.S.C. § 103 "would be requiring comparison of the results of the invention with the results of the invention", quoting *In re Chapman*, 357 F.2d 418, 148 USPQ 711 (CCPA 1966)). As discussed above, none of the cited references discloses a polymer bearing a POSS group with alkyl substituents which are not linked to the main chain (backbone) of the polymer containing up to 3 carbon atoms. Rather, the closest reference relied upon by the Office merely discloses that the POSS group can include alkyl and aryl substituents having 1 to 20 carbon atoms, but fails to exemplify any POSS groups with alkyl substituents containing up to 3 carbon atoms (*see* Lichtenhan at col. 5, lines 61-65), much less a random copolymer containing such groups, or to provide any motivation to select alkyl substituents containing up to 3 carbon atoms from the numerous suggested substituents. As a result, polymers comprising the MethacrylCyclopentyl-POSS monomer disclosed by Wu are the closest prior art. Thus, the applicants have compared the claimed material to the closest prior art and demonstrated that the claimed material demonstrates significantly improved performance. In this respect, the applicants submit that the compared material (MethacrylCyclopentyl-POSS homopolymer) is more closely related to the invention than the prior art relied upon by the examiner, which at best suggests a wide range of alkyl and aryl substitutes that may be suitable for use as the substituents of the POSS group. Thus, it is respectfully submitted that

the evidence of unexpected results properly compares the claimed invention to the closet prior art. *See* MPEP § 716.02(e) I ("Applicants may compare the claimed invention with prior art that is more closely related to the invention than the prior art relied upon by the examiner.").

In view of the foregoing, it is submitted that claims 1-5 and 7-13 are allowable over Angelopoulos, Lichtenhan, Nishi, Lin, and any combinations thereof.

NEW CLAIM 14

New independent claim 14 recites a lithographic material that contains a homopolymer bearing at least one polyhedral oligomeric silsesquioxane group, wherein the alkyl substituents of the polyhedral oligomeric silsesquioxane group which are not linked to the main chain (backbone) of the homopolymer comprise ethyl groups.

As evidenced by Example 3 of the specification, the inventors have unexpectedly discovered that a material comprising a homopolymer bearing a POSS group, with ethyl groups, can beneficially demonstrate significantly reduced rms roughness, which can allow for formation of smooth, high quality structures after pattern transfer. Specifically, Example 3 illustrates that a homopolymer in accordance with claim 14 (e.g., the MethacrylEthyl-POSS homopolymer of Example 3) demonstrates significantly reduced rms roughness as compared to a homopolymer bearing at least one polyhedral oligomeric silsesquioxane with alkyl substituents which are not linked to the main chain (backbone) of the homopolymer containing greater than 3 carbon atoms (e.g., the MethacrylCyclopentyl-POSS homopolymer of Example 3). Such unexpected, beneficial results were not recognized in any of the cited references. In fact, there is no suggestion in any of the cited references that the substituents of the POSS group could affect the pattern forming properties of a material having a polymer bearing the POSS group. In fact, none of the cited references provide a motivation to selectively choose an ethyl group as the R substituent of the POSS structure, as recited in claim 14. Accordingly, new claim 14 is allowable over the cited references.

CONCLUSION

It is submitted that the application is in condition for allowance. Should the examiner wish to discuss the foregoing, or any matter of form or procedure in an effort to advance this application to allowance, he is respectfully invited to contact the undersigned attorney at the indicated telephone number.

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Respectfully submitted,

By_____

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